

Europa Propulsion Valve Seat Material Testing

ABSTRACT

The Europa mission and spacecraft design presented unique challenges for selection of valve seat materials that met the fluid compatibility requirements, and combined fluid compatibility and high radiation exposure level requirements. The Europa spacecraft pressurization system valves will be exposed to fully saturated propellant vapor for the duration of the mission. The effects of Nitrogen Tetroxide (NTO) and Monomethylhydrazine (MMH) propellant vapors on heritage valve seat materials, such as Vespel SP-1 and Polychlorotrifluoroethylene (PCTFE), were evaluated to determine if an alternate material is required. In liquid system applications, Teflon is the only available compatible valve seat material. Radiation exposure data for Teflon in an air or vacuum environment has been previously documented. Radiation exposure data for Teflon in an oxidizer environment such as NTO, was not available, and it was unknown whether the effects would be similar to those on air-exposed samples. Material testing was conducted by Marshall Space Flight Center (MSFC) and White Sands Test Facility (WSTF) to determine the effects of propellant vapor on heritage seat materials for pressurization valve applications, and the effects of combined radiation and NTO propellant exposure on Teflon. The results indicated that changes in heritage pressurization valve seat materials' properties rendered them unsuitable for the Europa application. The combined radiation and NTO exposure testing of Teflon produced results equivalent to combined radiation and air exposure results.